इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 2166 (1963): Method for computation of capacity tables for horizontal and tilted oil storage tanks [PCD 1: Methods of Measurement and Test for Petroleum, Petroleum Products and Lubricants]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

IS : 2166 - 1963
(Reaffirmed 1996)

REAFFIRMED
-- 2007

Indian Standard

METHOD FOR COMPUTATION OF CAPACITY TABLES FOR HORIZONTAL AND TILTED OIL STORAGE TANKS

Sixth Reprint MARCH 1997
(Incorporating Amendment No. 1)

UDC 621.642.3 : 665.5 : 53.089.6

© Copyright 1970

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 6

October 1963

Indian Standard

METHOD FOR COMPUTATION OF CAPACITY TABLES FOR HORIZONTAL AND TILTED OIL STORAGE TANKS

Petroleum Measurements Sectional Committee, CDC 32

Chairman	*Representing*
DR H. K. JOSHI	ESSO Standard Refining Co of India Ltd, Bombay
Members	
SHRI V. J. BAKRE	Ministry of Finance (Revenue Division)
SHRI MANOHAR LAL (*Alternate*)	
SHRI T. B. BHONSLE	Central Public Works Department
EXECUTIVE ENGINEER (*Alternate*)	
SHRI E. M. BHUMGARA	Caltex (India) Ltd, Bombay; *and* Caltex Oil Refining (India) Ltd, Visakhapatnam
SHRI A. M. ARANHA (*Alternate*)	Caltex (India) Ltd, Bombay
SHRI N. S. RAO (*Alternate*)	Caltex Oil Refining (India) Ltd, Visakhapatnam
SHRI H. N. DESAI	Revenue & Industries Department (Government of Gujarat)
DIRECTOR	Indian Institute of Petroleum (CSIR), Dehra Dun
SHRI K. B. GANESAN	Directorate General of Civil Aviation (Ministry of Transport & Communications)
SHRI S. G. GHOSHALKAR	Railway Board (Ministry of Railways)
SHRI S. B. J. RAJAIH (*Alternate*)	
SHRI J. M. GUHA	Ministry of Mines & Fuel
MAJ S. T. KARNIK	Directorate of Supply & Transport, Quartermaster General's Branch, Army Headquarters
CAPT B. N. VAID (*Alternate*)	
SHRI A. S. KRISHNASWAMY	Indian Oil Co Ltd, Bombay
SHRI S. D. MEHTA	Indian Refineries Ltd, New Delhi
SHRI A. A. KRISHNAN (*Alternate*)	
SHRI N. A. MANDES	Indo-Burma Petroleum Co, Bombay
SHRI R. M. CHARI (*Alternate*)	
SHRI S. N. NAKHATE	ESSO Standard Eastern Inc, Bombay
SHRI A. N. NANDY	Ministry of Defence (R & D)
SHRI D. M. BANERJEE (*Alternate*)	
SHRI B. N. RANGWANI	Ministry of Finance (Revenue Division)
SHRI K. SRINIVASA RAO	Standing Metric Committee, Ministry of Commerce & Industry

(*Continued on page 2*)

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

(Continued from page 1)

Members	*Representing*
Shri T. R. Rao	Burmah-Shell Oil Storage & Distributing Co of India Ltd, Bombay
Shri A. S. Vaidya (*Alternate*)	
Shri K. K. Roy	Western India Oil Distribution Co Ltd, Bombay
Shri M. C. Desai (*Alternate*)	
Dr B. S. Subrahmanyam	Assam Oil Co Ltd, Digboi
Dr Sadgopal, Deputy Director (Chem)	Director, ISI (*Ex-officio Member*)

Secretary

Shri D. Das Gupta
Assistant Director (Chem), ISI

Calibration and Computation of Capacity Tables of Tanks (Other than Pressure Vessels) Subcommittee, CDC 32 : 2

Convener	
Shri T. R. Rao	Burmah-Shell Oil Storage & Distributing Co of India Ltd, Bombay

Members	
Shri A. S. Vaidya (*Alternate* to Shri T. R. Rao)	
Shri V. J. Bakre	Ministry of Finance (Revenue Division)
Shri Manohar Lal (*Alternate*)	
Shri E. M. Bhumgara	Caltex (India) Ltd, Bombay
Shri A. N. Kamte (*Alternate*)	
Shri K. V. Bole	Ministry of Finance (Revenue Division)
Shri B. S. Dhami	Engineer-in-Chief's Branch, Army Headquarters
Shri S. S. Raghavan (*Alternate*)	
Shri S. D. Mehta	Indian Refineries Ltd, New Delhi
Shri A. A. Krishnan (*Alternate*)	
The Surveyor of Works	Central Public Works Department

Indian Standard
METHOD FOR COMPUTATION OF CAPACITY TABLES FOR HORIZONTAL AND TILTED OIL STORAGE TANKS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 25 May 1963, after the draft finalized by the Petroleum Measurements Sectional Committee had been approved by the Chemical Division Council.

0.2 The problem of accurate measurement of bulk quantities of liquid petroleum products is not a simple one. Its solution involves accurate engineering and mathematical work, the skill of the experienced oil gauger, and the use of carefully standardized and calibrated equipment. Accuracy in measurement is essential in the sale, purchase and handling of oil. It not only obviates possible disputes between buyer and seller, but also provides the only reliable means of maintaining adequate control over storage and distribution losses.

0.3 The measurement of bulk quantities of liquid petroleum products involves various processes such as calibration and computation of capacity tables of tanks, gauging of tanks, temperature measurement of oils, and calculation of bulk quantities of oils in tanks. The need for accurate calibration of tanks cannot, therefore, be overemphasized. The object of this standard, therefore, is to lay down methods to be adopted uniformly in the country which will enable computation of capacity tables of horizontal and tilted cylinders.

0.4 Taking into consideration the views of producers, distributors and consumers, the Sectional Committee responsible for the preparation of this standard, felt that it should be related to the prevailing trade practices in the country in this field. Furthermore, due weightage had to be given to the need for international co-ordination among standards prevailing in different countries of the world in this field. These considerations led the Sectional Committee to base this standard on Petroleum Measurement Manual issued by the Institute of Petroleum (IP), London in 1952.

0.5 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS:2-1960 Rules for Rounding Off Numerical Values (*Revised*).

1. SCOPE

1.1 This standard prescribes the methods of computation of capacity tables for horizontal and tilted oil storage tanks intended for bulk storage of petroleum and liquid petroleum products.

2. GENERAL

2.1 The calculations shall be made in accordance with accepted mathematical principles.

2.2 At the head of each capacity table it shall be clearly stated that the dip/capacity relationship applies only to dips taken at one specified point. This point shall be clearly marked on the tank, and the height of the dipping reference point shall be recorded at the head of the capacity table.

3. FORM OF TANK TABLES

3.1 Provided that tank tables have been prepared in accordance with the principles laid down in this standard, the form in which the table is set out will not alter the accuracy of the figures obtained from it, but the following principles shall be applied in constructing tank tables:

a) The intervals of dip at which the tables are set out shall not be so great that interpolation for intermediate dips is difficult. It is convenient to set out tables at intervals of 1 cm.

b) Setting out short tables may be justifiable in some cases. But it shall be remembered that a comparatively longer table set out so that no interpolation is necessary is often quicker in use than a shorter table which needs interpolation. This is so since a single proportional parts table, applicable over the whole depth of the tank, cannot be constructed for horizontal and tilted cylindrical tanks.

c) It should be remembered that, at best, no oil measurements can be relied on to nearer than one part in 10 000. Commercial tables should never be set out to show any fractions of a litre and minor discrepancies, within the limit just mentioned, shall be disregarded.

d) In general, therefore, it is recommended that tables should be set out in complete litres against 1-cm intervals.

4. CORRECTIONS TO MEASURED CIRCUMFERENCES

4.1 Step-Overs

4.1.1 For each obstruction the excess or deficiency of the tape measurement spanning the obstruction as compared with the step-over interval for the course (ring) concerned shall be subtracted from the circumference, figure obtained by strapping, and the result shall be taken as the corrected circumference, free from error due to the displacement of the tape from its proper path by the obstructions concerned.

4.1.2 For all horizontal seams for which a step-over correction is detectable, it shall be included. In the case of horizontal seams, provided that the tape path used was entirely clear of rivet heads the following procedure may be adopted. An average step-over correction may be determined for each course (ring) and multiplied by the number of seams per course (ring) to obtain the total correction to be applied to the measured circumference of that course (ring) to compensate for such overlaps.

4.1.3 For single obstruction only step-over corrections 2 mm or over shall be so included.

4.1.4 The use of the step-over corrects circumferences for the effect on them of horizontal seam overlaps but does not correct the tank tables for the effect as deadwood of internal projections of the seam edges. These shall be computed and accounted for as deadwood.

4.2 Plate Thickness — Plate thickness measured shall be converted to the nearest 0·1 mm.

4.3 Temperature Correction — Where the strapping and dipping tapes are calibrated at 20°C and the tank table is to be corrected in use with the shell at 15°C, from each measured circumference shall be subtracted 0·000 09 times the measured circumference before the figure is taken into further calculation.

5. CALCULATIONS

5.1 The mean external circumference of any course (ring) shall be the average of the circumferences as measured on each course (ring) in accordance with 9 of IS:2009-1961 Method for Calibration of Horizontal and Tilted Oil Storage Tanks and corrected to the nearest 0·1 mm.

5.2 The mean internal circumference of the course (ring) shall then be calculated from the mean external circumference of the course (ring) by subtracting from the latter 2π times the plate thickness in metres.

5.3 The mean vertical diameter of each course (ring) shall be calculated from the measurements as are given in 10 of IS:2009-1961. It is not permissible to assume that it is equal to the mean internal circumference of that course, multiplied by $\frac{1}{\pi}$ unless it has been established by measurements that the tank is truly circular in section.

6. CORRECTIONS TO DIAMETER MEASUREMENTS

6.1 Measurements by Steel Tape and Dynamometer

6.1.0 The term vertical diameter is used in a normal sense as applicable to both horizontal and tilted tanks. It denotes a diameter measured in a vertical plane which bisects the tank longitudinally. It will be understood, however, that all diameters shall be measured perpendicular to the tank axis.

Mean vertical diameter is an average of several vertical diameters determined for a tank.

6.1.1 Calculate the mean diameter of each course (ring) as follows:

a) Average the tape readings obtained as in **17.3** of IS : 2009-1961 Method for Calibration of Horizontal and Tilted Oil Storage Tanks for each course (ring) by dividing the sum of all these readings on one course (ring) by their number.

b) Correct the average result as obtained under (a) for sag (*see* **6.1.3**).

c) Add to the result obtained in (b) the dynamometer length.

d) Where the measuring and dipping tapes are calibrated at 20°C, and the tank table is to be correct for use with the shell at 15°C, multiply the result obtained in (c) by (1 – 0·000 09) before the figure is taken into further calculation. Round off the resulting figure to the nearest 0·1 mm.

6.1.2 The mean vertical diameter of each course shall be calculated as follows:

a) Average the tape readings obtained on these diameters as in **17.3** of IS : 2009-1961 for each course by dividing the sum of all these readings on one course by their number.

b) Add to the result obtained in (a) the dynamometer length, rounding off the resulting figure to the nearest 0·1 mm.

6.1.3 *Corrections for Sag of Tape* — Deductions for the effect of sag shall be made from the average tape readings obtained in **6.1.1** (a). The correction Z for sag expressed in metres is given by the formula:

$$Z = \frac{1}{2} \frac{(W^2S^3)}{(24P^2)} = KS^3$$

where

P = pull in tape in kg,

S = span of tape in metres,

W = weight of tape in kg per metre, and

$K = \frac{1}{2} \times \frac{W^2}{24P^2}$.

For a tape 10 mm wide and 0·25 mm thick, made of steel of density 7 850 kg/m^3 values of *K* to give the correction in centimetres will be:

P	*K*
4·4 kg	$4{\cdot}2 \times 10^{-5}$
4·5 kg	$4{\cdot}0 \times 10^{-5}$
4·6 kg	$3{\cdot}9 \times 10^{-5}$

The above formula gives practically the same results as the equation of the catenary and is less cumbersome.

6.1.4 To the average diameter of each course (ring), corrected for sag, and the average vertical diameter without sag correction, add the length of the dynamometer when registering a pull of 4·5 kg.

6.1.5 Corrections for the effect of stretch are unnecessary because the tension applied is that at which the tape is standardized.

6.2 Measurements by Steel Rod and Rule

6.2.1 The mean diameter of each course (ring) shall be the sum of all diameters measured on that course (ring) in accordance with **17.4** of IS: 2009-1961 Method for Calibration of Horizontal and Tilted Oil Storage Tanks, divided by the number of diameters measured, this result being corrected for temperature as specified in **6.1.1** (d), and rounded off to the nearest 0·1 mm.

6.2.2 The mean vertical diameter for each course (ring) shall be the sum of all vertical diameters measured on that course (ring) in accordance with **17.4** of IS:2009-1961, divided by the number of vertical diameters measured, the result being rounded off to the nearest 0·1 mm.

7. CALCULATIONS

7.1 The mean diameter for the whole tank shall be calculated by taking for each course (ring) the product of the mean diameter as determined in **6.1.1** (a) or **6.2.1** and the length of the course (ring) in accordance with **18** of IS:2009-1961, and dividing the sum of product thus obtained by the sum of the lengths of the courses (rings). This result shall be calculated to the nearest 0·1 mm.

7.2 The internal circumference for the whole tank shall be calculated by taking for each course (ring) the product of the mean internal circumference as determined in **5.2** and the length of the course (ring) in accordance with **18** of IS:2009-1961 and dividing the sum of products thus obtained by the sum of the lengths of the courses (rings). This result shall be calculated to the nearest 0·1 mm.

8. PARTIAL OPEN CAPACITIES

8.1 Calculation — The partial open capacities of horizontal tanks, that is capacities without allowing for deadwood, are most easily calculated in the following way:

> The dip reading entered in the tank capacity table against which partial capacities will appear represents depths of liquid above the dipping datum point, and should be numbers of centimetres, suitably subdivided if desired, above the dipping datum point. For purpose of calculation these readings shall be adjusted as follows, but the adjusted readings are only required for this purpose and will not appear in the final table.
>
> *Firstly*, if the mean 'vertical' diameter as obtained in **6.2 2** is less than the actual 'vertical' diameter at the dip point (*see* **10.3** of IS: 2009-1961 Method for Calibration of Horizontal and Tilted Oil Storage Tanks), subtract from each dip reading half the difference of these two diameters. Conversely, if the mean 'vertical' diameter is greater than the actual 'vertical' diameter, add to each dip reading half the difference of these diameters.
>
> *Secondly*, if the dipping datum point is not at the same level as the point on the tank bottom from which the actual 'vertical' diameter referred to above has been measured, add to each dip reading the height of the dipping datum point above the tank bottom or subtract from each dip reading the distance of the dipping datum point below the tank bottom as the case may be.
>
> These two corrections will together form a constant correction which shall be applied to all dip readings as entered in the tank table to obtain oil dips to be used in the calculations outlined in subsequent clauses.

8.2 The following procedure shall be followed for calculating the partial volumes in horizontal cylinders:

a) *Partial Volume in Cylindrical Shell*

1) Calculate the total volume of the cylinder by the formula:

$$\frac{\pi D^2 L}{4}$$

where

D = mean internal diameter of the cylinder, and

L = length of the cylinder (including the straight flange of the heads).

2) Calculate $\frac{H}{D}$ ratios for various partial heights,

where

H = dip height as corrected in **8.1**, and

D = mean internal diameter of the cylinder.

3) Refer to Table II and read the coefficients corresponding to $\frac{H}{D}$ ratios determined in (2) above.

4) The partial volume in the cylinder for height,

H = total volume as calculated in (1) multiplied by coefficient as read out in (3).

b) *Partial Volume of Elliptical, Dished or Hemispherical Heads*

1) For elliptical or dished heads, calculate the total volume of the two heads by the formula:

$$\frac{\pi}{6} K D^3$$

where

K = ratio of the depth of the head (not including the straight flange) to the mean internal radius of the cylinder, and

D = mean internal diameter of the cylinder.

2) For hemispherical heads, the total volume of the two heads is given by the formula:

$$\frac{\pi}{6} D^3$$

where

D = mean internal diameter of the cylinder.

3) Refer to Table I and read the coefficients corresponding to $\frac{H}{D}$ ratios determined in (a) above.

4) For elliptical or dished heads, the partial volume in the two heads for height,

H = total volume as calculated in (1) multiplied by coefficient as read out in (3).

5) For hemispherical heads, the partial volume in the two heads for height,

H = total volume as calculated in (2) multiplied by coefficient as read out in (3).

c) The partial volume of the horizontal cylinder for height H is therefore the sum of the partial volumes as determined in (a) and (b) above.

8.3 Alternate Method — An alternate method for calculating the partial volumes by the use of geometric correlations is given in Appendix A.

8.4 An example indicating method of calculation is given in Appendix B.

9. DEADWOOD

9.1 The effect of small pieces of deadwood may be neglected, provided (a) that the total effect of any such neglect shall not lead to error in the tank tables exceeding 0·001 percent of the total capacity of the tank, and (b) that any 'vertical' deadwood so neglected is distributed evenly, or substantially so, over the whole height of the tank, and any 'circumferential' deadwood is distributed evenly, or substantially so, over the circumference of the tank.

9.1.1 In calculating the table, however, it shall be permissible to include the effect of any deadwood, however small.

10. BUTT WELDED TANKS

10.1 Some simplification is possible because of the absence of lap joints and 'courses' (rings).

10.1.1 In the case when circumferences have been measured, calculate as follows:

a) The mean external circumference for the whole of the cylindrical part of the tank shall be calculated by taking the sum of the external circumferences as measured in accordance with **9.5** of IS : 2009-1961 Method for Calibration of Horizontal and Tilted Oil Storage Tanks and **4.1** of this standard, divided by the number of circumferences measured. This result shall be rounded off to the nearest 0·1 mm.

b) The mean internal circumference for the whole of the tank shall then be calculated from the mean external circumference by subtracting from the latter 2π times the plate thickness in metres.

10.1.2 In the case where diameters have been measured directly, calculate as follows:

a) The mean diameter for the whole tank shall be calculated by taking the sum of the diameters obtained in accordance with **17.3** of IS : 2009-1961 divided by the number of measurements. This result shall be rounded off to the nearest 0·1 mm.

b) The mean vertical diameter for the whole tank shall be calculated by taking the sum of the vertical diameters obtained in accordance with **17.3** of IS : 2009-1961 Method for Calibration of Horizontal and Tilted Oil Storage Tanks, divided by the number of vertical diameters.

APPENDIX A

(*Clause* 8.3)

ALTERNATE METHOD FOR CALCULATING THE PARTIAL VOLUME BY GEOMETRIC CORRELATIONS

A-1. METHOD

A-1.1 The following alternate method may be used for calculating the partial volumes in horizontal cylinders.

A-1.1.1 *Partial Volume in Cylindrical Shell*

a) The oil dip (*see* **8.1**) divided by the mean vertical cylinder diameter (in consistent units) is equivalent to $\frac{1 - \cos A}{2}$, where $2A$ is the angle, in radians, subtended at the centre of the tank by the surface of the oil at the dip in question.

b) The partial capacity at this dip is then $LD^2 \times \frac{1}{4} (A - \frac{1}{2} \sin 2A)$, where

L = length of the cylinder, and
D = mean internal diameter.

A-1.1.2 *Partial Volume of Cylinder with Dished Ends*

a) Each dished end is considered to be a paraboloid of revolution of radius $D/2$ and height equivalent to the depth of dishing. The total capacity of this paraboloid is exactly one half of the capacity of a cylinder of radius $D/2$ and the same height. If P_1 and P_2 are the depths of dishing of the two ends of the tank, the partial capacities of tanks with dished ends are calculated by substituting $L + \frac{P_1 + P_2}{2}$ for L in the formula given in **A-1.1.1** (b) above, subject to correction given in (b) below.

b) The partial capacities thus calculated are corrected by adding the quantity:

$$-1/24 (\sin 2A - \tfrac{1}{2} \sin 4A) \frac{P_1 + P_2}{2} D^2$$

where $2A$ is as specified in **A-1.1.1** (a).

APPENDIX B

(*Clause* 8.4)

EXAMPLE OF COMPUTATION OF CAPACITY TABLES FOR A HORIZONTAL TANK WITH DISHED HEADS BY STRAPPING METHOD

B-1. DATA OBTAINED BY STRAPPING

COURSE (RING) NUMBER	MEASURED EXTERNAL CIRCUMFERENCE	STEP-OVER CORRECTIONS	LENGTH OF COURSE	PLATE THICKNESS	VERTICAL INTERNAL DIAMETER
	metres		metres	mm	metres
1 Left	9·420	Nil	3·000	10	2·979
1 Middle	9·423	,,			2·980
1 Right	9·423	,,			2·980
2 Left	9·423	,,	3·000	10	2·980
Middle	9·425	,,			2·978
2 Right	9·425	,,			2·978 (dip point)
3 Left	9·425	,,	3·000	10	2·979
3 Middle	9·423	,,			2·980
3 Right	9·422	,,			2·980.

Depth of heads	0·746 m
Distance of dip point from left side	4·500 m
Distance of dip point from right side	4·500 m
Level of dip point relative to the lowest point of a vertical diameter taken at either of the extreme ends	On the same level

B-2. ADDITIONAL DATA

a) Deadwood	Nil
Tape calibration temperature	20°C

B-3. CALCULATIONS

Course (Ring) No. 1

Mean external circumference at 20°C	9·422 m
Correction of calibration temperature of tape	−0·0008 m
	9·4212 m
Correction for plate thickness 10 × 6·2832	−0·0628 m
Corrected internal circumference	9·3584 m

COURSE (RING) NUMBER	MEAN INTERNAL CIRCUMFERENCE	MEAN INTERNAL DIAMETER	MEAN VERTICAL DIAMETER
	metres	metres	metres
1	9·3584	2·9777	2·9797
2	9·3607	2·9784	2·9787
3	9·3597	2·9781	2·9797

Mean diameter of the tank $\frac{2{\cdot}9777 + 2{\cdot}9784 + 2{\cdot}9781}{3} = 2{\cdot}9780$ m

Mean vertical diameter of the tank $\frac{2{\cdot}9797 + 2{\cdot}9787 + 2{\cdot}9797}{3} = 2{\cdot}9794$ m

Mean vertical internal diameter greater than the vertical internal diameter at the dip point by $2{\cdot}9794 - 2{\cdot}9780 = 0{\cdot}0014$ m

Positive correction to be applied while calculating partial capacities at each dip reading $= 0{\cdot}7$ mm

B-3.1 Partial Capacities — Using the method as given under **8.2**:

a) *Partial Volume in Cylindrical Shell*

1) Total volume of the cylinder $= \frac{\pi D^2 L}{4}$

$= \frac{3{\cdot}141\,6 \times 297{\cdot}81 \times 297{\cdot}81}{4} \times 900$

$= 62\,691\,975$ cm^3

$= \frac{62\,692}{1{\cdot}000\,028} = 62\,690$ litres

2) Typical dip reading $= 15$ cm

Corrected dip reading $= 15{\cdot}07$ cm

$H/D = \frac{15{\cdot}07}{297{\cdot}81} = 0{\cdot}050\,6$

3) From Table II, for

$H/D = 0{\cdot}050\,6$

Coefficient $= 0{\cdot}019\,026\,8$

4) Partial volume in the cylinder $= 0{\cdot}019\,026\,8 \times 62\,690$

$= 1\,193$ litres

b) *Partial Volume of Dished Ends*

1) Total volume of the two heads $= \frac{3{\cdot}141\,6}{6} \times \frac{74{\cdot}6}{297{\cdot}81} \times 2\,(297{\cdot}81)^3$

$= 6\,928\,625$ cm^3

$= \frac{6\,929}{1{\cdot}000\,028} = 6\,929$ litres

2) From Table I, for

$H/D = 0{\cdot}050\,6$

Coefficient $= 0{\cdot}007\,422\,8$

3) Partial volume in the two heads $= 0{\cdot}007\,422\,8 \times 6\,929$

$= 51$ litres

The total partial volume in the cylinder $= 1\,193 + 51$

$= 1\,244$ litres

B-3.2 Partial Capacities — Using the method as given in Appendix A:

Typical dip reading = 15 cm

Corrected dip reading = 15·07 cm

Mean Vertical Diameter $\frac{1 - \cos A}{2} = 0{\cdot}0506$

Therefore $A = 26^\circ = 0{\cdot}4538$ radiaus

Corrected dip $= \frac{15{\cdot}07}{297{\cdot}94} = 0{\cdot}0506$

Partial capacity with dished ends for a dip reading of 15 cm:

$$\left(L + \frac{P_1 + P_2}{2}\right) D^2 \times 1/4\,(A - 1/2 \sin 2A) - 1/24\,(\sin 2A - 1/2 \sin 4A)\,\frac{(P_1 + P_2)}{2} \times D^2$$

$$= [\,(900 + 74{\cdot}6) \times 297{\cdot}81 \times 297{\cdot}81 \times 0{\cdot}25\,(0{\cdot}4538 - 0{\cdot}5 \times 0{\cdot}788) - 1/24\,(0{\cdot}788 - 0{\cdot}5 \times 0{\cdot}9703) \times 74{\cdot}6 \times 297{\cdot}81 \times 297{\cdot}81\,]\,10^{-3} \div 1{\cdot}000028 \text{ litres}$$

$$= 1\,209/1{\cdot}000028 \text{ litres} = 1\,199 \text{ litres}$$

The table should be developed using the above procedure.

The calculating procedure remains practically the same when the tank is calibrated by internal measurements.

TABLE I COEFFICIENTS FOR PARTIAL VOLUMES OF ELLIPSOIDS (SPHERES)

H/D	0·000	0·001	0·002	0·003	0·004	0·005	0·006	0·007	0·008	0·009
0·00	0·000 000	0·000 003	0 000 012	0·000 027	0·000 048	0·000 075	0·000 108	0·000 146	0·000 191	0·000 242
0·01	0·000 298	0·000 360	0·000 429	0·000 503	0·000 583	0·000 668	0·000 760	0·000 857	0·000 960	0·001 069
0·02	0·001 184	0·001 304	0·001 431	0·001 563	0·001 700	0·001 844	0·001 993	0·002 148	0·002 308	0·002 474
0·03	0·002 646	0·002 823	0·003 006	0·003 195	0·003 389	0·003 589	0·003 795	0·004 006	0·004 222	0·004 444
0·04	0·004 672	0·004 905	0·005 144	0·005 388	0·005 636	0·005 893	0·006 153	0·006 419	0·006 691	0·006 968
0·05	0·007 250	0·007 538	0·007 831	0·008 129	0·008 433	0·008 742	0·009 057	0·009 377	0·009 702	0·010 032
0·06	0·010 368	0·010 709	0·011 055	0·011 407	0·011 764	0·012 126	0·012 493	0·012 865	0·013 243	0·013 626
0·07	0·014 014	0·014 407	0·014 806	0·015 209	0·015 618	0·016 031	0·016 450	0·016 874	0·017 303	0·017 737
0·08	0·018 176	0·018 620	0·019 069	0·019 523	0·019 983	0·020 447	0·020 916	0·021 390	0·021 869	0·022 353
0·09	0·022 842	0·023 336	0·023 835	0·024 338	0·024 847	0·025 360	0·025 879	0·026 402	0·026 930	0·027 462
0·10	0·028 000	0·028 542	0·029 090	0·029 642	0·030 198	0·030 760	0·031 326	0·031 897	0·032 473	0·033 053
0·11	0·033 638	0·034 228	0·034 822	0·035 421	0·036 025	0·036 633	0·037 246	0·037 864	0·038 486	0·039 113
0·12	0·039 744	0·040 380	0·041 020	0·041 665	0·042 315	0·042 969	0·043 627	0·044 290	0·044 958	0·045 630
0·13	0·046 306	0·046 987	0·047 672	0·048 362	0·049 056	0·049 754	0·050 457	0·051 164	0·051 876	0·052 592
0·14	0·053 312	0·054 037	0·054 765	0·055 499	0·056 236	0·056 978	0·057 724	0·058 474	0·059 228	0·059 987
0·15	0·060 750	0·061 517	0·062 288	0·063 064	0·063 843	0·064 627	0·065 415	0·066 207	0·067 003	0·067 804
0·16	0·068 608	0·069 416	0·070 229	0·071 046	0·071 866	0·072 691	0·073 519	0·074 352	0·075 189	0·076 029
0·17	0·076 874	0·077 723	0·078 575	0·079 432	0·080 292	0·081 156	0·082 024	0·082 897	0·083 772	0·084 652
0·18	0·085 536	0·086 424	0·087 315	0·088 210	0·089 109	0·090 012	0·090 918	0·091 829	0·092 743	0·093 660
0·19	0·094 582	0·095 507	0·096 436	0·097 369	0·098 305	0·099 245	0·100 189	0·101 136	0·102 087	0·103 042
0·20	0·104 000	0·104 962	0·105 927	0·106 896	0·107 869	0·108 845	0·109 824	0·110 808	0·111 794	0·112 784
0·21	0·113 778	0·114 775	0·115 776	0·116 780	0·117 787	0·118 798	0·119 813	0·120 830	0·121 852	0·122 876
0·22	0·123 904	0·124 935	0·125 970	0·127 008	0·128 049	0·129 094	0·130 142	0·131 193	0·132 247	0·133 305
0·23	0·134 366	0·135 430	0·136 498	0·137 568	0·138 642	0·139 719	0·140 799	0·141 883	0·142 969	0·144 059
0·24	0·145 152	0·146 248	0·147 347	0·148 449	0·149 554	0·150 663	0·151 774	0·152 889	0·154 006	0·155 127

(*Continued*)

TABLE I COEFFICIENTS FOR PARTIAL VOLUMES OF ELLIPSOIDS (SPHERES) — *Contd*

H/*D*	0·000	0·001	0·002	0·003	0·004	0·005	0·006	0·007	0·008	0·009
0·25	0·156 250	0·157 376	0·158 506	0·159 638	0·160 774	0·161 912	0·163 054	0·164 198	0·165 345	0·166 495
0·26	0·167 648	0·168 804	0·169 963	0·171 124	0·172 289	0·173 456	0·174 626	0·175 799	0·176 974	0·178 153
0·27	0·179 334	0·180 518	0·181 705	0·182 894	0·184 086	0·185 281	0·186 479	0·187 679	0·188 882	0·190 088
0·28	0·191 296	0·192 507	0·193 720	0·194 937	0·196 155	0·197 377	0·198 601	0·199 827	0·201 056	0·202 288
0·29	0·203 522	0·204 759	0·205 998	0·207 239	0·208 484	0·209 730	0·210 979	0·212 231	0·213 485	0·214 741
0·30	0·216 000	0·217 261	0·218 526	0·219 792	0·221 060	0·222 331	0·223 604	0·224 879	0·226 157	0·227 437
0·31	0·228 718	0·230 003	0·231 289	0·232 578	0·233 870	0·235 163	0·236 459	0·237 757	0·239 057	0·240 359
0·32	0·241 664	0·242 971	0·244 280	0·245 590	0·246 904	0·248 219	0·249 536	0·250 855	0·252 177	0·253 500
0·33	0·254 826	0·256 154	0·257 483	0·258 815	0·260 149	0·261 484	0·262 822	0·264 161	0·265 503	0·266 847
0·34	0·268 192	0·269 539	0·270 889	0·272 240	0·273 593	0·274 948	0·276 305	0·277 663	0·279 024	0·280 386
0·35	0·281 750	0·283 116	0·284 484	0·285 853	0·287 224	0.288 597	0·289 972	0·291 348	0·292 727	0·294 106
0·36	0·295 488	0·296 871	0·298 256	0·299 643	0·301 031	0·302 421	0·303 812	0·305 205	0·306 600	0·307 996
0·37	0·309 394	0·310 793	0·312 194	0·313 597	0·315 001	0·316 406	0·317 813	0·319 222	0·320 632	0·322 043
0·38	0·323 456	0·324 870	0·326 286	0·327 703	0·329 122	0·330 542	0·331 963	0·333 386	0·334 810	0·336 235
0·39	0·337 662	0·339 090	0·340 519	0·341 950	0·343 382	0·344 815	0·346 250	0·347 685	0·349 122	0·350 561
0·40	0·352 000	0·353 441	0·354 882	0·356 325	0·357 769	0·359 215	0·360 661	0·362 109	0·363 557	0·365 007
0·41	0·366 458	0·367 910	0·369 363	0·370 817	0·372 272	0·373 728	0·375 185	0·376 644	0·378 103	0·379 563
0·42	0·381 024	0·382 486	0·383 949	0·385 413	0·386 878	0·388 344	0·389 810	0·391 278	0·392 746	0·394 216
0·43	0·395 686	0·397 157	0·398 629	0·400 102	0·401 575	0·403 049	0·404 524	0·406 000	0·407 477	0·408 954
0·44	0 410 432	0·411 911	0·413 390	0·414 870	0·416 351	0·417 833	0·419 315	0·420 798	0.422 281	0·423 765
0·45	0·425 250	0·426 735	0·428 221	0·429 708	0·431 195	0·432 682	0·434 170	0·435 659	0·437 148	0·438 638
0·46	0·440 128	0·441 619	0·443 110	0·444 601	0·446 093	0·447 586	0·449 079	0·450 572	0·452 066	0·453 560
0·47	0·455 054	0·456 549	0·458 044	0·459 539	0·461 035	0·462 531	0·464 028	0·465 524	0·467 021	0·468 519
0·48	0·470 016	0·471 514	0·473 012	0·474 510	0·476 008	0·477 507	0·479 005	0·480 504	0·482 003	0·483 503
0 49	0·485 002	0·486 501	0·488 001	0·489 501	0·491 000	0·492 500	0·494 000	0·495 500	0·497 000	0·498 500

(*Continued*)

TABLE I COEFFICIENTS FOR PARTIAL VOLUMES OF ELLIPSOIDS (SPHERES) — *Contd*

H/D	0·000	0·001	0·002	0·003	0·004	0·005	0·006	0·007	0·008	0·009
0·50	0·500 000	0·501 500	0·503 000	0·504 500	0·506 000	0·507 500	0·509 000	0·510 499	0·511 999	0·513 499
0·51	0·514 998	0·516 497	0·517 997	0·519 496	0·520 995	0·522 493	0·523 992	0·525 490	0·526 988	0·528 486
0·52	0·529 984	0·531 481	0·532 979	0·534 476	0·535 972	0·537 469	0·538 965	0·540 461	0·541 956	0·543 451
0·53	0·544 946	0·546 440	0·547 934	0·549 428	0·550 921	0·552 414	0·553 907	0·555 399	0·556 890	0·558 381
0·54	0·559 872	0·561 362	0·562 852	0·564 341	0·565 830	0·567 318	0·568 805	0·570 292	0·571 779	0·573 265
0·55	0·574 750	0·576 235	0·577 719	0·579 202	0·580 685	0·582 167	0·583 649	0·585 130	0·586 610	0·588 089
0·56	0·589 568	0·591 046	0·592 523	0·594 000	0·595 476	0·596 951	0·598 425	0·599 898	0·601 371	0·602 843
0·57	0·604 314	0·605 784	0·607 254	0·608 722	0·610 190	0·611 656	0·613 122	0·614 587	0·616 051	0·617 514
0·58	0·618 976	0·620 437	0·621 897	0·623 356	0·624 815	0·626 272	0·627 728	0·629 183	0·630 637	0·632 090
0·59	0·633 542	0·634 993	0·636 443	0·637 891	0·639 339	0·640 785	0·642 231	0·643 675	0·645 118	0·646 559
0·60	0·648 000	0·649 439	0·650 878	0·652 315	0·653 750	0·655 185	0·656 618	0·658 050	0·659 481	0·660 910
0·61	0·662 338	0·663 765	0·665 190	0·666 614	0·668 037	0·669 458	0·670 878	0·672 297	0·673 714	0·675 130
0·62	0·676 544	0·677 957	0·679 368	0·680 778	0·682 187	0·683 594	0·684 999	0·686 403	0·687 806	0·689 207
0·63	0·690 606	0·692 004	0·693 400	0·694 795	0·696 188	0·697 579	0·698 969	0·700 357	0·701 744	0·703 129
0·64	0·704 512	0·705 894	0·707 273	0·708 652	0·710 028	0·711 403	0·712 776	0·714 147	0·715 516	0·716 884
0·65	0·718 250	0·719 614	0·720 976	0·722 337	0·723 695	0·725 052	0·726 407	0·727 760	0·729 111	0·730 461
0·66	0·731 808	0·733 153	0·734 497	0·735 839	0·737 178	0·738 516	0·739 851	0·741 185	0·742 517	0·743 846
0·67	0·745 174	0·746 500	0·747 823	0·749 145	0·750 464	0·751 781	0·753 096	0·754 410	0·755 720	0·757 029
0·68	0·758 336	0·759 641	0·760 943	0·762 243	0·763 541	0·764 837	0·766 130	0·767 422	0·768 711	0·769 997
0·69	0·771 282	0 772 563	0·773 843	0·775 121	0·776 396	0·777 669	0·778 940	0·780 208	0·781 474	0·782 739
0·70	0·784 000	0·785 259	0·786 515	0·787 769	0·789 021	0·790 270	0·791 516	0·792 761	0·794 002	0·795 241
0·71	0·796 478	0·797 712	0·798 944	0·800 173	0·801 399	0·802 623	0·803 845	0·805 063	0·806 280	0·807 493
0·72	0·808 704	0·809 912	0·811 118	0·812 321	0·813 521	0·814 719	0·815 914	0·817 106	0·818 295	0·819 482
0·73	0·820 666	0·821 847	0·823 026	0·824 201	0·825 374	0·826 544	0·827 711	0·828 876	0·830 037	0·831 196
0·74	0·832 352	0·833 505	0·834 655	0·835 802	0·836 946	0·838 088	0·839 226	0·840 362	0·841 494	0·842 624

(*Continued*)

TABLE I COEFFICIENTS FOR PARTIAL VOLUMES OF ELLIPSOIDS (SPHERES) — *Contd*

H/D	0·000	0·001	0·002	0·003	0·004	0·005	0·006	0·007	0·008	0·009
0·75	0·843 750	0·844 873	0·845 994	0·847 111	0·848 226	0·849 337	0·850 446	0·851 551	0·852 653	0·853 752
0·76	0·854 848	0·855 941	0·857 031	0·858 117	0·859 201	0·860 281	0·861 358	0·862 432	0·863 502	0·864 570
0·77	0·865 634	0·866 695	0·867 753	0·868 807	0·869 858	0·870 906	0·871 951	0·872 992	0·874 030	0·875 065
0·78	0·876 096	0·877 124	0·878 148	0·879 170	0·880 187	0·881 202	0·882 213	0·883 220	0·884 224	0·885 225
0·79	0·886 222	0·887 216	0·888 206	0·889 192	0·890 176	0·891 155	0·892 131	0·893 104	0·894 073	0·895 038
0·80	0·896 000	0·896 958	0·897 913	0·898 864	0·899 811	0·900 755	0·901 695	0·902 631	0·903 564	0·904 493
0·81	0·905 418	0·906 340	0·907 257	0·908 171	0·909 082	0·909 988	0·910 891	0·911 790	0·912 685	0·913 576
0·82	0·914 464	0·915 348	0·916 228	0·917 103	0·917 976	0·918 844	0·919 708	0·920 568	0·921 425	0·922 277
0·83	0·923 126	0·923 971	0·924 811	0·925 648	0·926 481	0·927 309	0·928 134	0·928 954	0·929 771	0·930 584
0·84	0·931 392	0·932 196	0·932 997	0·933 793	0·934 585	0·935 373	0·936 157	0·936 936	0·937 712	0·938 483
0·85	0·939 250	0·940 013	0·940 772	0·941 526	0·942 276	0·943 022	0·943 764	0·944 501	0·945 235	0·945 963
0·86	0·946 688	0·947 408	0·948 124	0·948 836	0·949 543	0·950 246	0·950 944	0·951 638	0·952 328	0·953 013
0·87	0·953 694	0·954 370	0·955 042	0·955 710	0·956 373	0·957 031	0·957 685	0·958 335	0·958 980	0·959 620
0·88	0·960 256	0·960 887	0·961 514	0·962 136	0·962 754	0·963 367	0·963 975	0·964 579	0·965 178	0·965 772
0·89	0·966 362	0·966 947	0·967 527	0·968 103	0·968 674	0·969 240	0·969 802	0·970 358	0·970 910	0·971 458
0·90	0·972 000	0·972 538	0·973 070	0·973 598	0·974 121	0·974 640	0·975 153	0·975 662	0·976 165	0·976 664
0·91	0·977 158	0·977 647	0·978 131	0·978 610	0·979 084	0·979 553	0·980 017	0·980 477	0·980 931	0·981 380
0·92	0·981 824	0·982 263	0·982 697	0·983 126	0·983 550	0·983 969	0·984 382	0·984 791	0·985 194	0·985 593
0·93	0·985 986	0·986 374	0·986 757	0·987 135	0·987 507	0·987 874	0·988 236	0·988 593	0·988 945	0·989 291
0·94	0·989 632	0·989 968	0·990 298	0·990 623	0·990 943	0·991 258	0·991 567	0·991 871	0·992 169	0·992 462
0·95	0·992 750	0·993 032	0·993 309	0·993 581	0·993 847	0·994 107	0·994 362	0·994 612	0·994 856	0·995 095
0·96	0·995 328	0·995 556	0·995 778	0·995 994	0·996 205	0·996 411	0·996 611	0·996 805	0·996 994	0·997 177
0·97	0·997 354	0·997 526	0·997 692	0·997 852	0·998 007	0·998 156	0·998 300	0·998 437	0·998 569	0·998 696
0·98	0·998 816	0·998 931	0·999 040	0·999 143	0·999 240	0·999 332	0·999 417	0·999 497	0·999 571	0·999 640
0·99	0·999 702	0·999 758	0·999 809	0·999 854	0·999 892	0·999 925	0·999 952	0·999 973	0·999 988	0·999 997
1·00	1·000 000									

TABLE II COEFFICIENTS FOR PARTIAL VOLUMES OF HORIZONTAL CYLINDERS

H/D	0·000	0·001	0·002	0·003	0·004	0·005	0·006	0·007	0·008	0·009
0·00	0·000 000	0·000 053	0·000 151	0·000 279	0·000 429	0·000 600	0·000 788	0·000 992	0·001 212	0·001 445
0·01	0·001 692	0·001 952	0·002 223	0·002 507	0·002 800	0·003 104	0·003 419	0·003 743	0·004 077	0·004 421
0·02	0·004 773	0·005 134	0·005 503	0·005 881	0·006 267	0·006 660	0·007 061	0·007 470	0·007 886	0·008 310
0·03	0·008 742	0·009 179	0·009 625	0·010 076	0·010 534	0·010 999	0·011 470	0·011 947	0·012 432	0·012 920
0·04	0·013 417	0·013 919	0·014 427	0·014 940	0·015 459	0·015 985	0·016 515	0·017 052	0·017 593	0·018 141
0·05	0·018 692	0·019 250	0·019 813	0·020 382	0·020 955	0·021 533	0·022 115	0·022 703	0·023 296	0·023 894
0·06	0·024 496	0·025 103	0·025 715	0·026 331	0·026 952	0·027 578	0·028 208	0·028 842	0·029 481	0·030 124
0·07	0·030 772	0·031 424	0·032 081	0·032 740	0·033 405	0·034 078	0·034 747	0·035 423	0·036 104	0·036 789
0·08	0·037 478	0·038 171	0·038 867	0·039 569	0·040 273	0·040 981	0·041 694	0·042 410	0·043 129	0·043 852
0·09	0·044 579	0·045 310	0·046 043	0·046 782	0·047 523	0·048 268	0·049 017	0·049 768	0·050 524	0·051 283
0·10	0·052 044	0·052 810	0·053 579	0·054 351	0·055 126	0·055 905	0·056 688	0·057 474	0·058 262	0·059 054
0·11	0·059 850	0·060 648	0·061 449	0·062 253	0·063 062	0·063 872	0·064 687	0·065 503	0·066 323	0·067 147
0·12	0·067 972	0·068 802	0·069 633	0·070 469	0·071 307	0·072 147	0·072 991	0·073 836	0·074 686	0·075 539
0·13	0·076 393	0·077 251	0·078 112	0·078 975	0·079 841	0·080 709	0·091 581	0·082 456	0·083 332	0·084 212
0·14	0·085 094	0·085 979	0·086 866	0·087 756	0·088 650	0·089 545	0·090 443	0·091 343	0·092 246	0·093 153
0·15	0·094 061	0·094 971	0·095 884	0·096 799	0·097 717	0·098 638	0·099 560	0·100 486	0·101 414	0·102 343
0·16	0·103 275	0·104 211	0·105 147	0·106 087	0·107 029	0·107 973	0·108 920	0·109 869	0·110 820	0·111 773
0·17	0·112 728	0·113 686	0·114 646	0·115 607	0·116 572	0·117 538	0·118 506	0·119 477	0·120 450	0·121 425
0·18	0·122 403	0·123 382	0·124 364	0·125 347	0·126 333	0·127 321	0·128 310	0·129 302	0·130 296	0·131 292
0·19	0·132 290	0·133 291	0·134 292	0·135 296	0·136 302	0·137 310	0·138 320	0·139 332	0·140 345	0·141 361
0·20	0·142 378	0·143 398	0·144 419	0·145 443	0·146 468	0·147 494	0·148 524	0·149 554	0·150 587	0·151 622
0·21	0·152 659	0·153 697	0·154 737	0·155 779	0·156 822	0·157 867	0·158 915	0·159 963	0·161 013	0·162 066
0·22	0·163 120	0·164 176	0·165 233	0·166 292	0·167 353	0·168 416	0·169 480	0·170 546	0·171 613	0·172 682
0·23	0·173 753	0·174 825	0·175 900	0·176 976	0·178 053	0·179 131	0·180 212	0·181 294	0·182 378	0·183 463
0·24	0·184 550	0·185 639	0·186 729	0·187 820	0·188 912	0·190 007	0·191 102	0·192 200	0·193 299	0·194 400

(Continued)

TABLE II COEFFICIENTS FOR PARTIAL VOLUMES OF HORIZONTAL CYLINDERS — *Contd*

H/D	0·000	0·001	0·002	0·003	0·004	0·005	0·006	0·007	0·008	0·009
0·25	0·195 501	0·196 604	0·197 709	0·198 814	0·199 922	0·201 031	0·202 141	0·203 253	0·204 368	0·205 483
0·26	0·206 600	0·207 718	0·208 837	0·209 957	0·211 079	0·212 202	0·213 326	0·214 453	0·215 580	0·216 708
0·27	0·217 839	0·218 970	0·220 102	0·221 235	0·222 371	0·223 507	0·224 645	0·225 783	0·226 924	0·228 065
0·28	0·229 209	0·230 352	0·231 498	0·232 644	0·233 791	0·234 941	0·236 091	0·237 242	0·238 395	0·239 548
0·29	0·240 703	0·241 859	0·243 016	0·244 173	0·245 333	0·246 494	0·247 655	0·248 819	0·249 983	0·251 148
0·30	0·252 315	0·253 483	0·254 652	0·255 822	0·256 992	0·258 165	0·259 338	0·260 512	0·261 687	0·262 863
0·31	0·264 039	0·265 218	0·266 397	0·267 578	0·268 760	0·269 942	0·271 126	0·272 310	0·273 495	0·274 682
0·32	0·275 869	0·277 058	0·278 247	0·279 437	0·280 627	0·281 820	0·283 013	0·284 207	0·285 401	0·286 598
0·33	0·287 795	0·288 992	0·290 191	0·291 390	0·292 591	0·293 793	0·294 995	0·296 198	0·297 403	0·298 605
0·34	0·299 814	0·301 021	0·302 228	0·303 438	0·304 646	0·305 857	0·307 068	0·308 280	0·309 492	0·310 705
0·35	0·311 918	0·313 134	0·314 350	0·315 566	0·316 783	0·318 001	0·319 219	0·320 439	0·321 660	0·322 881
0·36	0·324 104	0·325 326	0·326 550	0·327 774	0·328 999	0·330 225	0·331 451	0·332 678	0·333 905	0·335 134
0·37	0·336 363	0·337 593	0·338 823	0·340 054	0·341 286	0·342 519	0·343 751	0·344 985	0·346 220	0·347 455
0·38	0·348 690	0·349 926	0·351 164	0·352 402	0·353 640	0·354 879	0·356 119	0·357 359	0·358 599	0·359 840
0·39	0·361 082	0·362 325	0·363 568	0·364 811	0·366 056	0·367 300	0·368 545	0·369 790	0·371 036	0·372 282
0·40	0·373 530	0·374 778	0·376 026	0·377 275	0·378 524	0·379 774	0·381 024	0·382 274	0·383 526	0·384 778
0·41	0·386 030	0·387 283	0·388 537	0·389 790	0·391 044	0·392 298	0·393 553	0·394 808	0·396 063	0·397 320
0·42	0·398 577	0·399 834	0·401 092	0·402 350	0·403 608	0·404 866	0·406 125	0·407 384	0·408 645	0·409 904
0·43	0·411 165	0·412 426	0·413 687	0·414 949	0·416 211	0·417 473	0·418 736	0·419 998	0·421 261	0·422 525
0·44	0·423 788	0·425 052	0·426 316	0·427 582	0·428 846	0·430 112	0·431 378	0·432 645	0·433 911	0·435 178
0·45	0·436 445	0·437 712	0·438 979	0·440 246	0·441 514	0·442 782	0·444 050	0·445 318	0·446 587	0·447 857
0·46	0·449 125	0·450 394	0·451 663	0·452 932	0·454 201	0·455 472	0·456 741	0·458 012	0·459 283	0·460 554
0·47	0·461 825	0·463 096	0·464 367	0·465 638	0·466 910	0·468 182	0·469 453	0·470 725	0·471 997	0·473 269
0·48	0·474 541	0·475 814	0·477 086	0·478 358	0·479 631	0·480 903	0·482 176	0·483 449	0·484 722	0·485 995
0·49	0·487 269	0·488 542	0·489 814	0·491 087	0·492 360	0·493 633	0·494 906	0·496 179	0·497 452	0·498 726

(*Continued*)

TABLE II COEFFICIENTS FOR PARTIAL VOLUMES OF HORIZONTAL CYLINDERS — *Contd*

H/D	0·000	0·001	0·002	0·003	0·004	0·005	0·006	0·007	0·008	0·009
0·50	0·500 000	0·501 274	0·502 548	0·503 821	0·505 094	0·506 367	0·507 640	0·508 913	0·510 186	0·511 458
0·51	0·512 731	0·514 005	0·515 278	0·516 551	0·517 824	0·519 097	0·520 369	0·521 642	0·522 914	0·524 186
0·52	0·525 459	0·526 731	0·528 003	0·529 275	0·530 547	0·531 818	0·533 090	0·534 362	0·535 633	0·536 904
0·53	0·538 175	0·539 446	0·540 717	0·541 988	0·543 259	0·544 528	0·545 799	0·547 068	0·548 337	0·549 606
0·54	0·550 875	0·552 143	0·553 413	0·554 682	0·555 950	0·557 218	0·558 486	0·559 754	0·561 021	0·562 288
0·55	0·563 555	0·564 822	0·566 089	0·567 355	0·568 622	0·569 888	0·571 154	0·572 418	0·573 684	0·574 948
0·56	0·576 212	0·577 475	0·578 739	0·580 002	0·581 264	0·582 527	0·583 789	0·585 051	0·586 313	0·587 574
0·57	0·588 835	0·590 096	0·591 355	0·592 616	0·593 875	0·595 134	0·596 392	0·597 650	0·598 908	0·600 166
0·58	0·601 423	0·602 680	0·603 937	0·605 192	0·606 447	0·607 702	0·608 956	0·610 210	0·611 463	0·612 717
0·59	0·613 970	0·615 222	0·616 474	0·617 726	0·618 976	0·620 226	0·621 476	0·622 725	0·623 974	0·625 222
0·60	0·626 470	0·627 718	0·628 964	0·630 210	0·631 455	0·632 700	0·633 944	0·635 189	0·636 432	0·637 675
0·61	0·638 918	0·640 160	0·641 401	0·642 641	0·643 881	0·645 121	0·646 360	0·647 598	0·648 836	0·650 074
0·62	0·651 310	0·652 545	0·653 780	0·655 015	0·656 249	0·657 481	0·658 714	0·659 946	0·661 177	0·662 407
0·63	0·663 637	0·664 866	0·666 095	0·667 322	0·668 549	0·669 775	0·671 001	0·672 226	0·673 450	0·674 674
0·64	0·675 896	0·677 119	0·678 340	0·679 561	0·680 781	0·681 999	0·683 217	0·684 434	0·685 650	0·686 866
0·65	0·688 082	0·689 295	0·690 508	0·691 720	0·692 932	0·694 143	0·695 354	0·696 562	0·697 772	0·698 979
0·66	0·700 186	0·701 392	0·702 597	0·703 802	0·705 005	0·706 207	0·707 409	0·708 610	0·709 809	0·711 008
0·67	0·712 205	0·713 402	0·714 599	0·715 793	0·716 987	0·718 180	0·719 373	0·720 563	0·721 753	0·722 942
0·68	0·724 131	0·725 318	0·726 505	0·727 690	0·728 874	0·730 058	0·731 240	0·732 422	0·733 603	0·734 782
0·69	0·735 961	0·737 137	0·738 313	0·739 488	0·740 662	0·741 835	0·743 008	0·744 178	0·745 348	0·746 517
0·70	0·747 685	0·748 852	0·750 017	0·751 181	0·752 345	0·753 506	0·754 667	0·755 827	0·756 984	0·758 141
0·71	0·759 297	0·760 452	0·761 605	0·762 758	0·763 909	0·765 059	0·766 209	0·767 356	0·768 502	0·769 648
0·72	0·770 791	0·771 935	0·773 076	0·774 217	0·775 355	0·776 493	0·777 629	0·778 765	0·779 898	0·781 030
0·73	0·782 161	0·783 292	0·784 420	0·785 547	0·786 674	0·787 798	0·788 921	0·790 043	0·791 163	0·792 282
0·74	0·793 400	0·794 517	0·795 632	0·796 747	0·797 859	0·798 969	0·800 078	0·801 186	0·802 291	0·803 396

(*Continued*)

TABLE II COEFFICIENTS FOR PARTIAL VOLUMES OF HORIZONTAL CYLINDERS — *Contd*

H/D	0·000	0·001	0·002	0·003	0·004	0·005	0·006	0·007	0·008	0·009
0·75	0·804 499	0·805 600	0·806 701	0·807 800	0·808 898	0·809 993	0·811 088	0·812 180	0·813 271	0·814 361
0·76	0·815 450	0·816 537	0·817 622	0·818 706	0·819 788	0·820 869	0·821 947	0·823 024	0·824 100	0·825 175
0·77	0·826 247	0·827 318	0·828 387	0·829 454	0·830 520	0·831 584	0·832 647	0·833 708	0·834 767	0·835 824
0·78	0·836 880	0·837 934	0·838 987	0·840 037	0·841 085	0·842 133	0·843 178	0·844 221	0·845 263	0·846 303
0·79	0·847 341	0·848 378	0·849 413	0·850 446	0·851 476	0·852 506	0·853 532	0·854 557	0·855 581	0·856 602
0·80	0·857 622	0·858 639	0·859 655	0·860 668	0·861 680	0·862 690	0·863 698	0·864 704	0·865 708	0·866 709
0·81	0·867 710	0·868 708	0·869 704	0·870 698	0·871 690	0·872 679	0·873 667	0·874 653	0·875 636	0·876 618
0·82	0·877 597	0·878 575	0·879 550	0·880 523	0·881 494	0·882 462	0·883 428	0·884 393	0·885 354	0·886 314
0·83	0·887 272	0·888 227	0·889 180	0·890 131	0·891 080	0·892 027	0·892 971	0·893 913	0·894 853	0·895 789
0·84	0·896 725	0·897 657	0·898 586	0·899 514	0·900 440	0·901 362	0·902 283	0·903 201	0·904 116	0·905 029
0·85	0·905 939	0·906 847	0·907 754	0·908 657	0·909 557	0·910 455	0·911 350	0·912 244	0·913 134	0·914 021
0·86	0·914 906	0·915 788	0·916 668	0·917 544	0·918 419	0·919 291	0·920 159	0·921 025	0·921 888	0·922 749
0·87	0·923 607	0·924 461	0·925 314	0·926 164	0·927 009	0·927 853	0·928 633	0·929 531	0·930 367	0·931 198
0·88	0·932 028	0·932 853	0·933 677	0·934 497	0·935 313	0·936 128	0·936 938	0·937 747	0·938 551	0·939 352
0·89	0·940 150	0·940 946	0·941 738	0·942 526	0·943 312	0·944 095	0·944 874	0·945 649	0·946 421	0·949 190
0·90	0·947 956	0·948 717	0·949 476	0·950 232	0·950 983	0·951 732	0·952 477	0·953 218	0·953 957	0·954 690
0·91	0·955 421	0·956 148	0·956 871	0·957 590	0·958 306	0·959 019	0·959 727	0·960 431	0·961 133	0·961 829
0·92	0·962 522	0·963 211	0·963 896	0·964 577	0·965 253	0·965 927	0·966 595	0·967 260	0·967 919	0·968 576
0·93	0·969 228	0·969 876	0·970 519	0·971 158	0·971 792	0·972 422	0·973 048	0·973 669	0·974 285	0·974 897
0·94	0·975 504	0·976 106	0·976 704	0·977 297	0·977 885	0·978 467	0·979 045	0·979 618	0·980 187	0·980 750
0·95	0·981 308	0·981 859	0·982 407	0·982 948	0·983 485	0·984 015	0·984 541	0·985 060	0·985 573	0·986 081
0·96	0·986 583	0·987 080	0·987 568	0·988 053	0·988 530	0·989 001	0·989 466	0·989 924	0·990 375	0·990 821
0·97	0·991 258	0·991 690	0·992 114	0·992 530	0·992 939	0·993 340	0·993 733	0·994 119	0·994 497	0·994 866
0·98	0·995 227	0·995 579	0·995 923	0·996 257	0·996 581	0·996 896	0·997 200	0·997 493	0·997 777	0·998 048
0·99	0·998 308	0·998 555	0·998 788	0·999 008	0·999 212	0·999 400	0·999 571	0·999 721	0·999 849	0·999 947
1·00	1·000 000									

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002
Telephones: 323 0131, 323 3375, 323 9402
Fax : 91 11 3234062, 91 11 3239399, 91 11 3239382

Telegrams : Manaksanstha
(Common to all Offices)

Central Laboratory:	Telephone
Plot No. 20/9, Site IV, Sahibabad Industrial Area, SAHIBABAD 201010	8-77 00 32
Regional Offices:	
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	323 76 17
*Eastern : 1/14 CIT Scheme VII M, V.I.P. Road, Maniktola, CALCUTTA 700054	337 86 62
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43
Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113	235 23 15
†Western : Manakalaya, E9 Behind Marol Telephone Exchange, Andheri (East), MUMBAI 400093	832 92 95
Branch Offices:	
'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMEDABAD 380001	550 13 48
‡Peenya Industrial Area, 1st Stage, Bangalore - Tumkur Road, BANGALORE 560058	839 49 55
Gangotri Complex, 5th Floor, Bhadbhada Road, T. T. Nagar, BHOPAL 462003	55 40 21
Plot No. 62-63, Unit VI, Ganga Nagar, BHUBANESHWAR 751001	40 36 27
Kalaikathir Buildings, 670 Avinashi Road, COIMBATORE 641037	21 01 41
Plot No. 43, Sector 16 A, Mathura Road, FARIDABAD 121001	8-28 88 01
Savitri Complex, 116 G. T. Road, GHAZIABAD 201001	8-71 19 96
53/5 Ward No. 29, R. G. Barua Road, 5th By-lane, GUWAHATI 781003	54 11 37
5-8-58C, L. N. Gupta Marg, Nampally Station Road, HYDERABAD 500001	20 10 83
E-52, Chitaranjan Marg, C-Scheme, JAIPUR 302001	37 29 25
117/418 B, Sarvodaya Nagar, KANPUR 208005	21 68 76
Seth Bhawan, 2nd Floor, Behind Leela Cinema, Naval Kishore Road, LUCKNOW 226001	23 89 23
Patliputra Industrial Estate, PATNA 800013	26 23 05
T. C. No. 14/1421, University P. O. Palayam, THIRUVANANTHAPURAM 695034	6 21 17
NIT Building, Second Floor, Gokulpat Market, NAGPUR 440010	52 51 71
Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005	32 36 35

---

*Sales Office is at 5 Chowringhee Approach, P. O. Princep Street, CALCUTTA 700072	27 10 85
†Sales Office is at Novelty Chambers, Grant Road, MUMBAI 400007	309 65 28
‡Sales Office is at 'F' Block, Unity Building, Narashimaraja Square, BANGALORE 560002	222 39 71

Printed at New India Printing Press, Khurja, India